REMARKS

Applicants thank the Examiner for the thorough consideration given the present application.

Claims 1, 4-13, 15-24 and 35-40 are now present in this application. Claim 1 is independent.

Claims 1, 15 and 16 have been amended, claims 3 and 14 have been canceled and claims 37-40 have been added. Reconsideration of this application, as amended, is respectfully requested.

Rejections under 35 U.S.C. § 103

Claims 1, 3-6, 8-16, 23, 24 and 35 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Danforth in view of Sachs et al. and Gratson for the reasons set forth in paragraph 3 of the Office Action. Further, claims 7, 14-22 and 36 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Danforth in view of Sachs et al., Gratson and Hayes for the reasons set forth in paragraph 4 of the Office Action and claim 36 stands under 35 U.S.C. § 103(a) as being unpatentable over Danforth in view of Sachs et al., Gratson and either Uchiyama or Hertz for the reasons set forth in paragraph 5 of the Office Action. These rejections are respectfully traversed.

Complete discussions of the Examiner's rejections are set forth in the Office Action, and are not being repeated here.

While not conceding the appropriateness of the Examiner's rejection, but merely to advance prosecution of the instant application, Applicants respectfully submit that independent claim 1 has been amended to recite a combination of steps in a method of producing a three-dimensional structure including the steps of providing a needle-shaped nozzle body having a fine inside diameter at a tip thereof, the nozzle supplied with a fluid, arranging a tip of the nozzle to be close to a substrate, ejecting a fluid droplet having an ultra-fine diameter from the tip of the nozzle toward a surface of the substrate by applying a voltage having a prescribed waveform to the needle-shaped nozzle body via the electrode so as to make the droplet fly and land on the substrate, and thereby the droplet being dried to be a solidified substance after landing on the substrate, and maintaining a position and continually ejecting subsequent droplets by applying the prescribed waveform voltage to the nozzle for the droplets being stacked on said solidified

substance so as to form a grown three-dimensional structure. The nozzle inside diameter is 0.01 μm to 8μm. An electric line of force is attracted to the top of the solidified substance of the droplet, and wherein the three-dimensional structure is grown by stacking the subsequent flying droplet guided along the electric line of force onto the top of the solidified substance. A diameter of the ejected droplet is 15 μm or less.

Applicants respectfully submit that this combination of elements as set forth in independent claim 1 is not disclosed or made obvious by the prior art of record, including Danforth, Sachs et al. and Gratson.

The claim now recites, *inter alia*, maintaining a position and continually ejecting subsequent droplets using a nozzle having a diameter of 0.01 μm to 8 μm, forming droplets having a diameter of 15 μm or less, the droplets being dried to be a solidified substance after landing on the substrate, applying a voltage having a prescribed waveform to the needle-shaped nozzle body via the electrode, and an electric line of force is attracted to the top of the solidified substance of the droplet, wherein the three-dimensional structure is grown by stacking the subsequent flying droplet guided along the electric line of force onto the top of the solidified substance. These features are not disclosed or suggested by the prior art.

The Examiner makes the combination of Danforth, Sachs et al. and Gratson by merely noting that they are from the same field of endeavor and concluding that a combination of their disclosures would have been obvious to one of ordinary skill in the art. Without stating the rationale or motivation for combining prior art references, a rejection cannot be maintained. As provided in "Examination Guidelines Update, Federal Register/ Vol.75 No.169, the USPTO now clearly directs its Examiners on page 53645 that "*simply stating the principle (e.g. "art recognized equivalent", "structural similarity") without providing an explanation of its applicability to the facts of the case at hand is generally* ***NOT*** *sufficient to establish a prima facie case of obviousness* (emphasis added). The Guidelines Update instruct the Examiners that "*[i]f a rejection has been made that omits one of the required factual findings, and in response to the rejection a practitioner or inventor points out the omission, Office personnel must either withdraw the rejection, or repeat the rejection including all required factual findings*".

Danforth et al. discloses a conventional dispenser, not a droplet ejector, without using the specific waveform voltage applied via an electrode. The dispenser is a completely different type than the claimed dispenser. Danforth utilizes melting-solidifying effect of a molten material by

heating a disperser head for forming the structured filament (see col. 10 ll.14-29). Even if dispersion can be applied to the dispenser, it would be a paste material. This is distinctly different from the ejection of ultrafine droplets attained by the present invention.

Moreover, Danforth et al. discloses droplets ejection (see col.25 ll.45-52), but this is employed by an indirect method, i.e., forming a structure by using a forming mold (see Fig.6, mold 200). This truly coincides with conventional understanding as to giving up forming a 3D-structured material from droplets directly. On the other hand, the present invention overcomes the restriction of the conventional art and attains 3D-structures directly from ejected droplets by the size of micron order droplets.

Danforth discloses a dispenser that has no need for using a specific waveform voltage. The Examiner refers to columns 10 and 11 which describe a method of forming a photonic bandgap device 100 having a lattice structure. The material is deposited in layers from material from a filament 10 melted in a dispensing head. The filament 10 has a diameter of between 0.010 inches and 0.50 inches (ie. 254 – 12,700 μm), making the use of a nozzle having an inner diameter of 0.01 μm to 8 μm not feasible. There is also no disclosure that the material is ejected in droplets. The Examiner refers to column 6, lines 60-65, but this disclosure refers to the particulate solid material within the filament 10 which forms a solid particle filled fluid material when melted. There is no disclosure to eject droplets rather than dispensing a continuous stream like tubing mayonnaise or tooth paste to build a lattice structure.

Sachs fails to disclose solidified droplets forming a three dimensional structure and uses a nozzle having a diameter of 50 μm, not less than 50 μm as alleged by the Examiner at the top of page 4 of the Office Action. This diameter is much larger than the claimed nozzle diameter. Sachs discloses the use of a periodic voltage means 20 attached to a charging cell 23 and plates 25 creating an electric field to apply a charge to droplets to influence where the drops fall on the substrate 30. However, the drops are not stacked on one another, as the printhead scans back and forth over the powder bed. The charging of the droplets moves the drops laterally from a line 35 followed by an uncharged droplet. The result is laterally spaced droplets, not vertically stacked. As explained in column 6, lines 19-36, the result is finer resolution on equipment that is easier to fabricate. There is no application of Sach's teaching to the disclosure of Danforth which discloses making a lattice structure photonic bandgap device. As stated above, there is no advantage to have the dispensing head 14 of Danforth dispense droplets, and there is certainly no

reason to use a nozzle having a diameter of 0.01 μm to 8μm, forming droplets having a diameter of 15 μm or less to build a photonic bandgap device that is much bigger than the nozzle diameter.

The Examiner relies upon Gratson for disclosing the use of a nozzle having a diameter of 0.01 μm to 8 μm, stating that Gratson is merely from the same field of endeavor in forming three dimensional structures of micron-scale features. Gratson et al. discloses a filament product made of polyelectrolyte which is chemically reacted by being dipped in a deposition bath. Specifically, the polyelectrolyte droplets are solidified via a liquid phase chemical reaction when they are contacting the deposition bath containing reactive compounds (see paragraphs [0016] [0024] [0043]-[0045] Fig. 3B, 3C). It is unreasonable to remove only the size information of the nozzle apart from a liquid phase reaction of the cited invention. Thus, there is no reasonable ground of a motivation to combine the element of Gratson et al. with Danforth et al.

The dispenser disclosed in Graston et al is not a droplet jet device for ejecting the droplets to be flying and landing. Generally, such dispenser squeezes out liquid or paste by pressure (Graston et al [0029]), and is used for directly attaching or slowly tubing a material to a medium. Further to say, a dispenser disclosed in Graston et al. is not a droplet jet device for the droplets to be flying and landing. Generally, such dispensers squeeze out liquid or paste by pressure (Graston et al. [0029]) and are used for directly attaching or slowly dropping it to a medium. If necessary, reference can be made to the website disclosing the device, Model 800 ULTLA Dispenser, employed in the example shown in the specification (Graston et al. [0043]). http:www.efd-inc.com/NR/rdonlyres/00DEA5C6-25FF-4C7F-8E72-271468477001/0/EFD80D Manual.pdf

In addition, the cited art of Graston et al. does neither teach nor suggest the essential element of the present invention, i.e., steps of droplets drying and solidifying during the flight (never it happens in a liquid phase), much less a focused electric force at a nozzle end effecting the growing structure. Further, a Ø10 μm nozzle for the dispenser is available, but Ø8 μm or more less is quite difficult to control in light of operation of the dispenser. Further to say, practically speaking, a Ø0.1 μm nozzle can never be realistic for the dispenser.

The other references relied upon by the Examiner also do not render the claimed invention obvious. Hayes discloses a method of forming a solder bump by dropping molten solder droplets. Hayes depends on liquid-solid transformation of solder, but not drying

(vaporizing) and solidifying action of droplets. Further, the nozzle diameter employed is on the order of 50 μm, which is much larger than the presently claimed nozzle. Thus, the effect of the focused electric field at the nozzle end can be expected, and accordingly the presently claimed invention is neither taught nor suggested in the cited art reference. Likewise, the nozzle diameter employed in the cited art is 10 μm (Uchiyama et al) and 20 μm (Herts et al), which are larger than the presently claimed range.

Applicants respectfully submit that the combination of elements as set forth in independent claim 1 is not disclosed or made obvious by the prior art of record, including Danforth, Sachs et al. and Gratson, for the reasons explained above. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

With regard to dependent claims 4-13, 15-24 and 35-37, Applicants submit that claims 4-13, 15-24 and 35-37 depend, either directly or indirectly, from independent claim 1 which is allowable for the reasons set forth above, and therefore claims 4-13, 15-24 and 35-37 are allowable based on their dependence from claim 1. Reconsideration and allowance thereof are respectfully requested.

Declaration under 37 CFR 1.132

Applicants submit a declaration of one of the inventor, Mr. Kazuhiro Murata, setting forth the unexpected results of the invention. The Examiner is respectfully requested to consider the strong evidence set forth in the declaration when considering the strength of the rejection set forth in the Office Action.

New Claims

Claims 37-40 have been added for the Examiner's consideration. Support for claims 37, 39 and 40 can be fund in the paragraph beginning on page 11, line 17. Support for claim 38 can be found on page 11, line 7. Applicants submit that claims 37-40 depend, either directly or indirectly, from independent claim 1, and are therefore allowable based on their dependence from claim 1 which is believed to be allowable.

In addition, claims 37-40 recite further limitations which are not disclosed or made obvious by the applied prior art references.

Consideration and allowance of claims 37-40 are respectfully requested.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance.

In view of the above amendment, Applicants believe the pending application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Christopher J. McDonald, Registration No. 41,533, at the telephone number of the undersigned below to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Director is hereby authorized to charge any fees required during the pendency of the above-identified application or credit any overpayment to Deposit Account No. 02-2448.

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Respectfully submitted,

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